

Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): In a packet switched computer network, a method of estimating periodic worst-case delay for a class of traffic-aggregate having an associated rate, the method comprising:

collecting traffic data at a queue of a router over a time interval, said queue associated with the class of traffic aggregate over a time interval, the traffic data comprising packet size and arrival time of each packet arriving at the queue during the time interval;

calculating a burst-rate traffic profile responsive to the traffic data collected at said queue over said the time interval and the associated rate, wherein the associated rate is a specified bandwidth for the class of traffic-aggregate and calculating the burst-rate traffic profile comprises calculating a burst parameter based on the associated rate; and

calculating a periodic worst-case delay for the burst-rate traffic profile by dividing the calculated burst parameter by a share of output link bandwidth allotted to said queue, wherein the share of output link bandwidth is greater than or equal to the associated rate; wherein the associated rate is set to a rate negotiated between a customer and a provider for the class of traffic.

Claim 2 (canceled).

Claim 3 (canceled).

Claim 4 (canceled).

Claim 5 (canceled).

Claim 6 (canceled).

Claim 7 (canceled).

Claim 8 (canceled).

Claim 9 (previously presented): In a packet switched network, a method of estimating worst-case queuing delay along a path, said path comprising routers, the method comprising:

periodically collecting a rate parameter and a burst parameter associated with a queue for each of a plurality of routers, the burst parameter calculated based on a specified bandwidth;

calculating a periodic worst-case delay associated with the rate and burst parameters for said each of a plurality of routers, wherein calculating a periodic worst-case delay comprises dividing the burst parameter by a share of output link bandwidth allotted to the queue, wherein the share of output link bandwidth is greater than or equal to the specified bandwidth; and

adding up the calculated periodic worst-case delay associated with the routers along the path.

Claim 10 (canceled).

Claim 11 (currently amended): In a packet switched network, a method of estimating periodic worst-case queuing delay for a class of traffic at a router, the class of traffic having a negotiated rate, the method comprising:

receiving packets at an input interface of a router;
sending each packet to one of a plurality of streams responsive to a customer identification;
sending each packet in at least one of the plurality of streams to one of a plurality of queues responsive to a class field, each of said plurality of queues having an associated rate;
monitoring an arrival time and size of said each packet at the one of the plurality of queues during an interval of time;
~~calculating a burst parameter based on the negotiated rate;~~
calculating a burst-rate traffic profile responsive to the arrival time and size of said each packet and the negotiated rate, wherein calculating a burst-rate traffic profile comprises calculating a burst parameter based on the negotiated rate; and
calculating a periodic worst-case delay for the burst-rate traffic profile by dividing the burst parameter by an output link capacity allotted to the queue corresponding to the class of traffic, ~~the output link capacity greater than or equal to the associated rate.~~

Claim 12 (canceled).

Claim 13 (canceled)

Claim 14 (currently amended): In a packet switched network, an apparatus for estimating worst-case delay for a class of traffic-aggregate having an associated rate, the apparatus comprising:

 a monitor that collects traffic data comprising arrival time and size of packets arriving at a queue of a router over a time interval, said queue associated with the class of traffic-aggregate over a time interval;

 a processor; and

 a computer readable medium coupled to the processor and storing a computer program comprising:

 code that causes the processor to receive the traffic data comprising packet size and arrival time of each packet arriving at the queue during the time interval;

 code that causes the processor to calculate a burst-rate traffic profile responsive to the collected traffic data and the associated rate, wherein the associated rate is a specified bandwidth for the class of traffic-aggregate and code that causes the processor to calculate a burst-rate traffic profile comprises code that causes the processor to calculate a burst parameter based on the associated rate; and

 code that causes the processor to calculate a periodic worst-case delay for the traffic profile by dividing the burst parameter by a share of output link bandwidth allotted to the queue, wherein the associated rate is set to a rate negotiated between a customer and a provider for the class of traffic~~the share of output link bandwidth is greater than or equal to the associated rate~~.

Claim 15 (canceled).

Claim 16 (canceled).

Claim 17 (canceled).

Claim 18 (canceled).

Claim 19 (previously presented): An apparatus as in claim 14, wherein the computer readable medium is a CD-ROM, floppy disk, flash memory, system memory, or hard drive.

Claim 20 (previously presented): In a packet switched network, an apparatus for estimating periodic worst-case queuing delay along a path, said path comprising routers, the apparatus comprising:

a monitor agent that periodically collects traffic parameters associated with a queue for each of a plurality of routers;

a processor that can receive information from the monitor agent; and

a computer readable medium coupled to the processor and storing a computer program comprising:

code that causes the processor to receive burst and rate traffic parameters collected by the monitor agent;

code that causes the processor to calculate a delay associated with the traffic parameters for said each of a plurality of routers by dividing the burst parameter by a share of output link bandwidth allotted to the queue, wherein the share of output link bandwidth is greater than or equal to the specified bandwidth; and

code that causes the processor to add up the calculated periodic worst-case delay associated with the routers along the path.

Claim 21 (canceled).

Claim 22 (previously presented): The apparatus of claim 20, wherein the computer readable medium is a CD-ROM, floppy disk, flash memory, system memory, or hard drive.

Claim 23 (currently amended): In a packet switched network, an apparatus for estimating periodic worst-case delay for a class of traffic aggregate having an associated rate, the apparatus comprising:

means for collecting traffic data comprising arrival time and size of packets arriving at a queue of a router over a time interval, said queue associated with the class of traffic aggregate over a time interval, the traffic data comprising packet size and arrival time of each packet arriving at the queue during the time interval;

means for calculating a burst-rate traffic profile responsive to the collected traffic data and the associated rate, wherein the associated rate is a specified bandwidth for the network and means for calculating the burst-rate traffic profile comprises means for calculating a burst parameter based on the associated rate; and

means for calculating a periodic worst-case delay for the traffic profile by dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein the associated rate is set to a rate negotiated between a customer and a provider for the class of traffic ~~share of output link bandwidth is greater than or equal to the associated rate~~.

Claim 24 (canceled).

Claim 25 (previously presented): In a packet switched network, an apparatus for estimating periodic worst-case queuing delay along a path, said path comprising routers, the apparatus comprising:

means for periodically collecting rate and burst traffic parameters associated with a queue for each of a plurality of routers, the burst traffic parameter calculated based on a specified bandwidth;

means for calculating a delay associated with the traffic parameters for said each of a plurality of routers by dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein the share of output link bandwidth is greater than or equal to the associated rate; and

means for adding up the calculated periodic worst-case delay associated with the routers along the path.

Claim 26 (canceled).

Claim 27 (previously presented): A computer program product for estimating periodic worst-case delay at a queue in a packet switched network, the computer program product comprising:

computer code that causes a processor to collect traffic data comprising arrival time and size of packets arriving at the queue of a router over a time interval, said traffic data having an associated negotiated rate;

computer code that causes a processor to calculate a burst traffic parameter for the collected traffic;

computer code that causes a processor to calculate a burst-rate traffic profile responsive to the collected traffic data and the associated negotiated rate;

computer code that causes a processor to calculate a periodic worst-case delay for the traffic profile by dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein the share of output link bandwidth is greater than or equal to the associated rate; and

a computer readable medium storing said computer code.

Claim 28 (canceled).

Claim 29 (previously presented): A computer program product for estimating worst-case queuing delay along a path in a packet switched network, said path comprising routers, the computer program product comprising:

computer code that causes a processor to collect burst and rate traffic parameters associated with a queue for each of a plurality of routers;

computer code that causes the processor to calculate a delay associated with the traffic parameters for said each of a plurality of routers by dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein the share of output link bandwidth is greater than or equal to the associated rate; and

computer code that causes the processor to add up the calculated delay associated with the routers along the path; and

a computer readable storage medium storing said code.

Claim 30 (canceled).

Claim 31 (previously presented): In a packet switched network, a method of estimating worst-case queuing delay along a path, said path comprising routers, the method comprising:

calculating periodic worst-case delay associated with a queue for each of a plurality of routers by dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein the share of output link bandwidth is greater than or equal to the associated rate;

periodically collecting periodic worst-case delay from said each of a plurality of routers; and

adding up the calculated periodic worst-case delay associated with the routers along the path.

Claim 32 (canceled).

Claim 33 (previously presented): The method of claim 1 wherein calculating the burst-rate traffic profile comprises utilizing a token bucket.

Claim 34 (previously presented): The method of claim 33 wherein the token bucket size corresponds to a maximum burst rate.

Claim 35 (currently amended): The method of claim 33 wherein a replenishment rate of the token bucket is based on the associated rate.

Claim 36 (previously presented): The method of claim 1 wherein the burst parameter is calculated utilizing token buckets ~~and the associated rate is set to a negotiated rate for a specified class of traffic.~~

Claim 37 (previously presented): The method of claim 1 wherein the associated rate is a maximum average bandwidth specified in a service level agreement.

Claim 38 (previously presented): The method of claim 1 wherein the burst-rate traffic profile comprises a y-intercept corresponding to the calculated burst parameter and a slope corresponding to the associated rate.

Claim 39 (previously presented): The method of claim 1 further comprising calculating a cumulative bandwidth profile having a slope equal to allocated bandwidth.

Claim 40 (previously presented): The method of claim 1 further comprising calculating error of data by comparing collected data to the burst-rate traffic profile.

Claim 41 (previously presented): The method of claim 40 further comprising calculating a new burst parameter if the error of data is higher than a predetermined limit.

Claim 42 (previously presented): The apparatus of claim 14 wherein code that causes the processor to calculate the burst-rate traffic profile comprises code that causes the processor to utilize a token bucket.

Claim 43 (previously presented): The apparatus of claim 42 wherein the token bucket size corresponds to a maximum burst rate.

Claim 44 (currently amended): The method of claim 9 wherein the burst parameter is calculated utilizing token buckets ~~and the associated rate is set to a negotiated rate for a specified class of traffic.~~

Claim 45 (previously presented): The method of claim 9 wherein the rate parameter is a rate agreed to by a customer sending the traffic data.

Claim 46 (previously presented): The method of claim 11 further comprising calculating error of data by comparing collected data to the burst-rate traffic profile.

Claim 47 (previously presented): The apparatus of claim 23 wherein the burst-rate traffic profile comprises a y-intercept corresponding to the calculated burst parameter and a slope corresponding to the associated rate.

Claim 48 (new): The apparatus of claim 14 wherein said share of output link bandwidth allotted to said queue comprises a hypothetical bandwidth allocation.

Claim 49 (new): The apparatus of claim 14 wherein the negotiated rate comprises a hypothetical negotiated rate.

Claim 50 (new): The method of claim 1 further comprising calculating a hypothetical bandwidth allocation for said queue based on a specified periodic worst-case delay.

Claim 51 (new): The method of claim 11 further comprising transmitting said calculated periodic worst-case delay to a central device configured to collect said calculated periodic worst-case delay from routers along a path in the network and add up the collected periodic worst-case delay associated with each of the routers.